

Cruise Results

NOAA RV MILLER FREEMAN and RV CHAPMAN

Cruise MF83-01, Leg III and IV and CH83-02, Leg II

Shelikof Strait and Western Gulf of Alaska
Echo Integrator-Midwater Trawl Survey of
Spawning Pollock (Theragra chalcogramma)

Introduction

The largest documented pollock spawning concentration in the western Gulf of Alaska occurs in Shelikof Strait, mainly from mid February through March. A great deal of interest has been expressed in the concentration because of its commercial value and as an indicator of the condition of the pollock stock in the west-central Gulf. In response, echo integration-midwater trawl surveys have been conducted in Shelikof Strait in 1980, 1981 and 1983. The 1983 survey is described and some preliminary results are presented.

Cruise Period, Area, and Itinerary

MILLER FREEMAN

The MILLER FREEMAN completed an echo integrator-midwater trawl survey of Shelikof Strait, and the outer shelf/upper slope (50-200 fm) area southwest of Kodiak Island and along the Alaska Peninsula, on April 13, 1983. During Leg III, a survey of the area between Albatross Bank (southeast of Kodiak) to southwest of Chirikof Island and two surveys of Shelikof Strait were completed (Fig. 1A). The outer shelf/upper slope area from Unimak Island to Chirikof Island and Shelikof Strait were surveyed on Leg IV (Fig. 1B). The cruise itinerary was:

March 2-3	Equipment installation, Kodiak
March 3-20	Leg III survey; Albatross Bank to southwest of Chirikof Island (March 3-6) and 2 surveys of Shelikof Strait (March 6-20).
March 21-22	In-port, Kodiak
March 23-24	Transit to survey area
March 25-April 13	Leg IV survey; Unalaska Island to Chirikof Island (March 25-April 6) and Shelikof Strait (April 6-13).

CHAPMAN

The **CHAPMAN** completed an echo integrator-midwater trawl survey of Shelikof Strait and the east side of Kodiak Island (Fig. 2) on April 10. The Shelikof Strait survey was started near Kupreanoff Strait and ended west of the Trinity Islands. The east side of Kodiak Island was surveyed from near Cape Trinity to Portlock Bank. The vessel itinerary was:

March 23	Equipment installation, Kodiak.
March 24-April 3	Survey of Shelikof Strait
April 5-10	Survey of Cape Trinity to Portlock Bank area.

OBJECTIVES

The MILLER FREEMAN and CHAPMAN echo integrator - midwater trawl surveys were conducted as a comprehensive survey of spawning pollock in the western Gulf of Alaska. About 65 percent of the survey effort was expended in Shelikof Strait. The remainder was used to conduct exploratory surveys from Unimak Island to East of Kodiak Island. The primary objectives were to: (1) collect echo integration data necessary to determine the distribution and biomass of the off bottom component of pollock aggregations, (2) collect data necessary to determine their biological composition (sex, size, age and maturity), and (3) to collect data on the timing of peak spawning of the Shelikof Strait concentration.

Data on the on-bottom component of the Shelikof Strait pollock aggregation was collected during a bottom trawl survey conducted by the CHAPMAN (see cruise results; CHAPMAN, Cruise 83-01), during Leg III of the MILLER FREEMAN cruise.

ACOUSTIC EQUIPMENT AND TRAWL GEAR

MILLER FREEMAN

Echo integration data were collected using a Biosonics^{1/} model 101 echo sounder and a model 120 digital echo integrator. The integrator output was interfaced to a Radio Shack model III computer for preliminary data handling and storage on floppy disk memory. The echo sounder operated at 38 KHz, using a pulse width of 0.6 ms. A dead weight body containing the transducer (6° full beam angle) was towed behind the ship at a depth of approximately 16 m, at a speed of about 8.5 kn.

The midwater trawl used throughout the survey was a Diamond-1000, equipped with a 1.25 in (3.2 cm) ccd end liner. It was fished with two 275 lb (125 kg) tom weights and 6 x 9 ft. (1.8 x 2.7 m) steel Vee doors. Net operation was monitored using a third-wire type, headrope mounted netsounder. The vertical mouth opening varried from 15 to 18 m (about 8-10 fin).

^{1/} Reference to trade names of commercial firms does not imply endorsement by the National Marine Fisheries Service, NOAA.

CHAPMAN

The echo integration system used on the CHAPMAN was the same as that on the MILLER FREEMAN, except that it included a smaller transducer (10° full angle) mounted in a Vee-fin towing body, which was towed at a depth of about 19 m at an average speed of 7 kn.

Midwater trawl gear was the same as that on the MILLER FREEMAN. In addition, an 83-112 bottom trawl, fished with the same doors as the midwater trawl, was used on 3 occasions. The bottom trawl was also equipped with a 1.25 inch (3.2 cm) mesh cod end liner

SURVEY METHODS

Surveys were conducted on a 24 hour/day schedule on the MILLER FREEMAN and the CHAPMAN. Echo integration data were collected along zig-zag tracklines with approximate 10 nm spacing between adjacent transect end points except for the second MILLER FREEMAN survey in Shelikof Strait, which had 15 nm spacing. Outside of Shelikof Strait, transects were run between the 50 and 200 fm contours and within Shelikof Strait, between the 50 fm contours. Echo integration values (fish density estimates in kg/m^3) were output after each 5 minutes of transecting time, for selected depth intervals from 5 m below the transducer to the sea bed.

Trawl hauls were made on selected concentrations of fish for species identification and to obtain pollock biological data and samples. The total number and weight of fish in each haul was determined for each species, either by sorting the entire catch or a sample, depending upon catch quantities. Pollock sex, length and maturity composition data were collected from 150-250 randomly selected fish in every haul. In addition, for most hauls, about 100 individual otoliths and 50 length-weight measurement/stomach content observations were collected. Two special purpose collections of pollock ovaries and one of scales were obtained. A limited amount of data on other species (mostly length frequencies) was also collected.

RESULTS

The MILLER FREEMAN ran a total of 4398 trackline miles and completed 45 midwater trawl hauls. The CHAPMAN ran 1434 trackline miles and completed 11 midwater and 3 bottom trawl hauls. Trawl haul locations are shown in Figure 3. The frequency of occurrence of species taken in midwater trawl hauls is shown in Table 1. Catch data (by haul) are summarized in Tables 2 and 3. The numbers of pollock sampled for different types of biological data/samples are shown in tables 4 and 5. The total catch by species (% by weight) on the MILLER FREEMAN was: pollock, 91.7%; Pacific cod, 4.5%; eulachon, 2.1% and; other species, 1.6%. The CHAPMAN catch was: pollock, 98.5%; Pacific cod, 0.4%; eulachon, 0.3% and; other species, 1.6%.

With one exception, only trace amounts of pollock were found in the regions surveyed outside the Shelikof Strait-Semidi Island area, so none of those echo integration data were analyzed. A small aggregation of pollock, extending over an area of about 4-5 Km² was found near Sanak Island, at Sandman Reefs. In contrast, the area of the pollock aggregation inside the Shelikof Strait-Semidi Island area ranged from 12,123 Km², during its heaviest concentration (just prior to spawning; survey 2, March 16-19), to 19,700 Km² after the start of its post spawning dispersion (Fig. 4). Preliminary maturity composition data indicate that peak spawning occurred from March 19-30. During the second MILLER FREEMAN survey of Shelikof Strait (March 16-19), 75 percent of the females (> 30 cm length) were mature and about 3 percent were spawning. In contrast, during the CHAPMAN survey (March 25-April 3), 15 percent of all females (> 30 cm length) were spawning and 65 percent were spent.

The pollock biomass estimates for the first and second MILLER FREEMAN surveys in Shelikof Strait were 2.466 and 2.360 million t, respectively. The estimates for the CHAPMAN survey (0.903 million t) and for the third MILLER FREEMAN survey (0.819 million t) were much lower due to the post spawning breakup of the aggregation which occurred before either survey was conducted. A very low biomass estimate was also obtained for the 1980 survey (conducted during a similar time period), indicating that timing is critical and estimates of peak biomass of the Shelikof Strait aggregation may not be reliable for surveys conducted much outside March 1-25. The major factors that influence the timing of peak spawning are not well known.

The conduct of the Shelikof Strait surveys in relation to the movements of pollock into, and within, the spawning area could have effected the accuracy of biomass estimation. Thus, the average of the survey 1 and 2 biomass estimates (2.413 million t) is considered to be a more appropriate estimate of the peak biomass for 1983 than are the individual survey estimates, and is used throughout the remainder of this report where age specific biomass or populations of pollock are given.

Preliminary estimates were made of age specific biomass and populations of pollock, based on age and age specific weight composition data from eight trawl hauls made during the first leg of the MILLER FREEMAN survey. Age specific biomass (B_i) was calculated by;

$$\hat{B}_i = \frac{\bar{W}_i N_i}{(\bar{W}_t N_t)} \hat{B}_t ,$$

where \bar{W}_i and N_i are the weight-at mean length and the number of pollock in the eight hauls, at age i ; B_t is total estimated biomass. Age specific numbers of pollock in the population were then estimated by dividing B_i by \bar{W}_i . Estimated age specific biomass and populations as well as percentage age compositions, sex ratios, mean lengths and weights of the pollock in the eight trawl hauls, are presented in Table 6. Total biomass and confidence interval estimates for the 1980, 1981 and 1983 surveys are presented for comparison in Table 7.

Further analyses and interpretation of the survey data are in progress and will be reported elsewhere.

SCIENTIFIC PERSONNEL

MILLER FREEMAN

Edmund Nunnallee	(3/2 - 4/61	Chief Scientist, NWAFC
Martin Nelson	(3/2 - 3/23; 4/6 - 4/13)	Fishery Biologist, NWAFC
Neal Williamson	(3/2 - 3/23)	Statistician, NWAFC
John Garrison	(3/2 - 4/13)	Electronics Tech. NWAFC
Eric Stirrup	(3/2 - 4/13)	NOAA Corps Officer, NWAFC
Greg Jensen	(3/2 - 4/13)	Biological Tech. , NWAFC
John Rosapepe	(3/22 - 4/13)	Biological Tech., NWAFC
Daniel Doty	(3/22 - 4/13)	Biological Tech. , NWAFC

Leg III and IV

CHAPMAN

Jimmie Traynor	(3/23 - 4/10)	Chief Scientist, NWAFC
Neal Williamson	(3/23 - 4/10)	Statistician, NWAFC
Dion Powell	(3/23 - 4/10)	Biological Tech. , NWAFC
Becky Talty	(3/23 - 4/10)	Biological Tech., NWAFC
Jeff Parkhurst	(3/23 - 4/10)	Biological Tech. , NWAFC

Leg II

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Table 1. List of species taken by midwater trawl and their frequency of occurrence in 56 hauls during Leg III and IV of MILLER FREEMAN Cruise 83-01 and Leg II of CHARMAN Cruise 83-02.

Species	Frequency of occurrence (no. of hauls)
Lamnidae	
<u>Lamna ditropis</u> (Salmon shark)	1
Rajidae	
<u>Raja binoculata</u> (Big skate)	3
Clupeidae	
<u>Clupea harengus pallasii</u> (Pacific herring)	2
Salmnidae	
<u>Oncorhynchus tshawytscha</u> (Chinook salmn)	2
Osmeridae	
<u>Thaleichthys pacificus</u> (Eulachon)	35
Myctophidae	
(Unidentified lanternfish)	2
Gadidae	
<u>Gadus macrocephalus</u> (Pacific cod)	32
<u>Theragra chalcogramma</u> (Walleye pollock)	56
Scorpaenidae	
<u>Sebastes aleutianus</u> (Rougheye rockfish)	3
Cyclopteridae	
<u>Aptocyclus ventricosus</u> (Smooth lumpsucker)	15
Pleuronectidae	
<u>Atheresthes stomias</u> (Arrowtooth flounder)	19
<u>Hippoglossus stenolepis</u> (Pacific halibut)	3
<u>Hippoglossoides elassodon</u> (Flathead sole)	11
<u>Lepidopsetta bilineata</u> (Rock sole)	2
<u>Reinhardtius hippoglossoides</u> (Greenland turbot)	1
Pandalidae	
<u>Pandalopsis dispar</u> (Sidestripe shrimp)	2
Others	
(Unidentified jellyfish)	14
(Unidentified ctenophore)	1
(Unidentified salps)	1

Table 2. Summary of midwater trawl station and catch data; MILLER FREEMAN Cruise 83-01, Legs III and IV. All hauls except nos. 27-31 were made in Shelikof Strait.

Haul	Date	Time	Start Position		Depth (fm) (Gear/ Bottom)	Duration (Min)	Water Temp. Surface/ Gear (°C)	Catch (lbs)			
			Lat. (N)	Long. (W)				Pollock	Eulachon	Pacific Cod	Other
1	3/9	1300	56°35.0'	155°53.2'	124/142	30	4.5/5.2	1661.5	13.0	12.5	10.0
2	3/9	1600	56°44.2'	155°51.5'	144/159	10	4.2/5.7	1439.5	78.5	13.5	2.0
3	3/10	1300	57°00.0'	155°46.3'	104/151	10	4.0/5.0	367.0	45.5	----	----
4	3/10	1500	56°59.0'	155°41.1'	140/157	10	4.0/5.0	4343.9	18.9	170.0	12.0
5	3/10	1600	56°56.1'	155°40.8'	133/157	20	4.0/5.0	2187.0	5.0	14.0	14.0
6	3/11	1000	57°01.7'	155°01.3'	78/88	25	4.3/5.1	3310.0	2.0	----	----
7	3/11	1200	57°00.7'	155°17.1'	113/137	19	4.0/---	560.5	1.0	----	6.0
8	3/12	1000	57°35.9'	155°08.2'	120/142	1	4.2/---	2100.0	---	26.0	3.0
9	3/12	1100	57°34.1'	155°15.1'	110/153	30	4.2/5.3	566.0	48.5	9.0	7.5
10	3/12	1400	57°19.0'	155°41.5'	136/149	20	3.8/---	3154.3	159.3	----	----
11	3/13	1700	57°29.3'	155°03.2'	114/128	30	4.7/4.8	1989.0	51.3	15.8	21.1
12	3/14	1100	57°52.7'	154°26.6'	79/126	5	4.1/---	6967.0	----	----	----
13	3/14	1200	57°53.6'	154°31.5'	108/130	--	4.0/---	17101.0	----	899.0	----
14	3/14	1600	57°45.3'	155°02.0'	158/170	18	4.2/5.2	No Catch - Gear Problem			

Table 2. (continued)

Haul	Date	Time	Start Position		Depth (fm) (Gear/ Bottom)	Duration (Min)	Water Temp. Surface/ Gear (°C)	Catch (lbs)			
			Lat. (N)	Long. (W)				Pollock	Eulachon	Pacific Cod	Other
15	3/14	1800	57°43.9'	155°02.0'	136/151	7	3.1/6.2	1293.0	1.0	6.0	----
16	3/15	1900	58°00.8'	154°19.4'	128/148	2	3.3/6.1	2950.0	----	----	----
17	3/16	1500	56°50.2'	155°38.6'	140/154	2	4.0/6.0	2823.8	17.2	----	----
18	3/17	1100	57°20.6'	155°28.1'	130/145	1	4.4/---	900.0	----	----	14.0
19	3/17	1300	57°21.9'	155°33.3'	123/155	43	4.4/---	419.0	2.0	----	----
20	3/18	0900	57°46.1'	155°00.3'	153/170	4	4.4/4.6	1225.0	1.0	6.0	3.0
21	3/18	1200	57°35.0'	155°23.8'	149/176	5	4.3/6.3	748.0	----	----	8.0
22	3/18	1400	57°27.2'	155°21. 8'	134/148	4	4.4/---	1282.0	1.0	12.0	5.0
23	3/19	1500	58°08.7'	153°29.2'	95/115	30	4.8/5.2	286.0	5.0	23.0	----
24	3/19	1900	57°58.6'	154°19.6'	114/136	2	5.0/6.5	399.0	----	7.0	0.5
25	3/19	0000	57°47.2'	155°01. 9'	128/145	13	4.6/6.3	751.0	1.0	41.0	2.0
26	3/20	0900	57°27.7'	155°27.4'	138/158	1	4.6/5.9	454.0	1.0	----	----
27	3/25	1700	53°25.8'	165°49.6'	170/275	30	4.7/6.3	1.0	----	----	0.2
28	3/27	Aborted because of trawl system hydraulic problems									
29	3/28	2100	54°30.5'	162°25.6'	46/79	42	2.6/3.2	400.0	----	462.0	5.0
30	3/30	1800	54°31.5'	160°49.1'	140/180	48	3.5/5.4	697.0	----	---	1.0

Table 2. continued

Haul	Date	Time	Start Position		Depth (fm) (Gear/ Bottom)	Duration (Min)	Water Temp. Surface/ Gear (°C)	Catch (lbs)			
			Lat. (N)	Long. (W)				Pollock	Eulachon	Pacific Cod	Other
31	3/31	1600	55°34.6'	160°18.2'	97/103	6	5.0/3.7	1400.00	----	5.0	----
32	4/6	1900	55°55.5'	156°40.1'	36/109	18	5.1/4.5	1390.0	----	----	----
33	4/7	0900	56°25.6'	156°14.5'	118/145	108	4.8/5.0	1765.0	9.0	42.0	4.0
34	4/7	2200	56°38.6'	155°54.7'	100/145	60	5.2/5.5	871.0	54.5	92.0	14.0
35	4/8	1000	56°47.1'	155°09.4'	35/45	30	4.9/5.1	1376.0	----	20.0	4.0
36	4/9	0900	57°08.4'	155°47.2'	138/153	30	5.0/5.0	1616.4	----	157.0	5.1
37	4/9	1100	56°06.8'	155°47.2'	85/151	48	5.0/5.0	512.0	5.0	----	--
38	4/9	2100	57°20.1'	154°57.8'	98/111	12	5.4/5.0	348.0	0.7	----	.6
39	4/10	1200	57°39.8'	155°00.2'	130/140	150	5.4/5.2	1034.0	7.0	43.0	40.0
40	4/10	1900	57°39.9'	154°20.6'	57/71	6	5.4/5.2	483.0	----	----	----
41	4/11	1400	58°01.3'	154°20.1'	105/144	< 1	4.2/5.2	341.0	----	----	----
42	4/11	1600	58°01.9'	154°16.6'	90/150	26	4.2/5.2	417.0	----	----	----
43	4/12	1400	58°36.2	152°47.0	73/104	18	6.6/5.5	352.0	----	----	.09
44	4/12	2000	58°13.5'	153°18.3'	109/118	60	6.2/5.5	2716.9	----	120.0	.7
45	4/13	0600	57°58.9'	154°17.8'	116/129	12	5.4/5.7	1373.0	1.0	70.0	----

Table 3. Summary of midwater and bottom trawl station and catch data; CHAPMAN Cruise 83-02, Leg II.

Haul	Date	Time	Start Position		Depth(fm) Gear/Bottom	Duration (Min)	Water Temp (°C) Surface/Gear	Catch (lbs.)			
			Lat. (N)	Long. (W)				Pollock	Eulachon	Pacific Co	Other
1	3/30	0900	57°50.1'	154°43.8'	118/138	29	5.3/5.0	560.5	0.2	11.0	14.5
2	3/30	1000	57°49.8'	154°42.9'	103/145	13	5.3/5.0	302.5	0.1	3.0	1.7
3	3/30	2000	57°34.1'	155°04.9'	80/130	4	5.1/---	319.5	0.8	10.5	0.5
4	3/30	2100	57°35.7'	155°10.8'	149/150	35	5.1/---	2042.5	0.2	30.1	3.9
5	3/31	2000	57°24.9'	155°11.5'	90/33	24	4.8/---	2958.1	17.2	27.5	1.2
6(B)	3/31	2100	57°24.0'	155°12.6'	133/133	10	4.8/---	1319.4	20.5	45.0	---
7	4/01	1800	56°56.3'	155°14.8'	60/122	15	4.8/---	596.0	----	----	0.2
8	4/01	2000	56°54.1'	155°11.2'	94/120	30	5.0/---	2578.2	46.5	6.0	13.3
9	4/02	1800	56°36.6'	155°22.8'	30/50	26	4.6/---	5220.5	----	----	----
10	4/06	0800	57°03.7'	152°45.1'	75/95	60	4.9/---	95.0	0.1	----	1.0
11	4/06	1800	57°09.2'	152°25.5'	68/83	53	4.8/---	8918.9	----	----	150.0
12(B)	4/06	2000	57°08.5'	152°26.5'	86/86	27	4.6/5.5	2.0	----	22.0	1692.8
13(B)	4/08	0800	57°34.1'	151°46.5'	85/85	30	3.8/---	71.5	----	249.5	2179.0
14	4/09	0800	57°49.6'	148°45.3'	152/154	15	4.6/5.5	297.5	0.5	5.0	7.8

(B) denotes bottom trawl haul.

Table 4. Numbers of pollock sampled for various ~~t~~ of biological data/samples, by haul, on MILLER FREEMAN Cruise 83-01, Leg III and IV

HAUL	LENGTHS	OTOLITHS	MATURITIES	WEIGHTS	STOMACH SCANS ^{1/}	OVARIES	SCALES
1	357	125	178	53	47	42	—
2	363	51	119	68	52	—	—
3	161	54	54	—	—	—	—
4	378	128	177	49	—	21	—
5	326	—	143	—	51	—	—
6	163	87	123	36	—	—	—
7	118	68	109	41	—	—	—
8	300	117	117	—	—	—	—
9	327	75	75	—	—	—	—
10	244	73	73	—	—	—	—
11	299	123	183	60	52	—	—
12	379	84	138	54	—	—	—
13	302	120	172	52	—	—	—
14	—	—	—	—	—	—	—
15	322	140	264	124	—	—	—
16	268	125	153	28	50	—	—
17	267	133	133	—	—	—	—
18	292	108	127	19	—	—	—
19	237	81	121	40	—	—	—
20	282	139	151	12	—	—	—
21	271	135	159	24	—	—	—
22	290	70	97	27	—	—	—
23	211	107	107 tog	—	—	—	—
24	300	140	216	76	50	—	—
25	281	140	209	69	—	—	—
26	270	132	302 201	69	—	—	—
27	—	—	—	—	—	—	—
28	—	—	—	—	—	—	—
29	295	99	156	57	—	—	—
30	325	100	164	64	—	—	100
31	357	59	119	60	25	—	—
32	280	140	207	67	35	—	—
33	552	137	241	104	24	—	—
34	185	91	129	38	38	—	—
35	343	184	242 216	58	34	—	—
36	286	140	215	75	51	—	—
37	263	123	263	140	52	—	—
38	248	124	159 158	35	10	—	—
39	281	137	205	68	51	—	—
40	343	100	172 198	72	27	—	—
41	341	117	160	43	—	—	—
42	315	135	135	—	—	—	—
43	372	125	125	—	10	—	—
44	140	140	— No	—	—	—	—
45	289	138	138	—	—	—	—
Totals	12,515	4,644	6,566	1,782✓	659	63	100

^{1/} Cursory examination of stomach contents with gross estimates of volume for major taxa recorded

Table 5. Numbers of pollock sampled for various types of biological data/samples, by haul, on CHAPMAN Cruise 83-02, Leg II.

HALL	LENGTHS	OTOLITHS	MATURITIES	WEIGHTS	STOMACH SCANS ^{1/}
1	179	50	199 110	60	—
2	209	50	209 182	133 132	—
3	222	50	222 122	72	—
4	259	—	— 71	—	—
5	237	50	95	—	—
6	313	—	116	—	—
7	380	—	28	28	—
8	271	50	116	66	10
9	302	99	180 179	81 80	20
10	88	88	100 88	— 88	20
11	206	— 25	88 74	78 49	10
12	—	—	—	—	—
13	304	113	210	97	—
14	— 304	— 113	— 238	— 125	21
Totals	2,970	550 575	— 1,419	615 700	81

^{1/} Cursory examination of stomach contents with gross estimates of volume for major taxa recorded.

Table 6. Preliminary age specific biomass (10^3 t) and population (numbers $\times 10^6$) estimates of pollock and their mean length (cm) and weight (g) at mean length for the first and second ~~MILLER~~ FREEMAN surveys (~~combined~~) of Shelikof Strait in 1983.

	<u>AGE</u>										
	1	2	3	4	5	6	7	8	9	10	11
Sex ratio <u>1/</u>		.53	.46	.55	.60	.63	.58	.50	.60		
Biomass <u>2/</u>	.	28.9	74.2	503.9	767.1	569.7	371.0	65.5	22.4	5.0	5.2
% of total		1.2	3.1	20.9	31.8	23.6	15.4	2.7	0.9	0.2	0.2
Numbers <u>3/</u>		372.0	244.6	1268.9	1452.3	927.4	662.5	91.7	2.5	5.1	5.1
% of total		7.4	4.8	25.1	28.7	18.3	13.1	1.8	0.5	0.1	0.1
Mean length											
Males		22.4	33.6	38.0	41.6	43.3	41.6	45.1	45.3		52.0
Females		23.0	36.6	39.0	42.8	45.8	44.6	47.7	56.0	52.0	
combined		22.7	35.2	38.4	42.1	44.2	42.9	46.4	49.6	52.0	52.0
Weight at mean length (gm) <u>4/</u>											
Males		75.5	259.9	378.1	498.2	562.9	498.2	637.3	646.0		983.5
Females		80.4	344.8	420.7	563.0	696.2	640.6	790.8	1307.5	1036.5	
Combined	.	77.8	303.2	397.1	528.2	614.3	560.0	714.2	878.3	1016.9	1016.9

1/ sex ratio = proportion males

2/ total pollock biomass = $2,043 \times 10^3$ t (mean of estimates for ~~MILLER~~ FREEMAN surveys 1 and 2)

3/ total number = $5,055 \times 10^6$ pollock

4/ wights calculated using length/weight regression coefficients

Table 7. Estimated pollock biomass in Shelikof Strait in 1980, 1981 and 1983.

Year	Survey	Survey dates <u>1/</u>	Biomass (t)	95 % Confidence interval (t)		
1980	1	April 11-14	708,983	566,024	-	815,942
1981	1	March 3-15	4,380,032	2,922,163	-	5,837,900
	2	March 24-27	3,147,444	2,073,752	-	4,230,533
	Mean of surveys 1 & 2		3,763,738	2,857,028	-	4,670,448
	3	April 4-10	3,050,096	2,022,384	-	4,077,807
1983	1	March 6-15	2,465,753	1,536,062	-	3,395,445
	2	March 16-19	2,360,348	1,260,685	-	3,460,011
	Mean of surveys 1 & 2		2,413,051	1,693,054	-	3,133,048
	3 <u>2/</u>	March 25-April 3	903,634	466,424	-	1,340,843
	4	April 6-13	818,932	571,784	-	1,066,080

1/ Survey dates include **only** days when echo integration data **were** collected.

2/ Survey conducted by CHAPMAN; **all** others by MILLER FREEMAN.

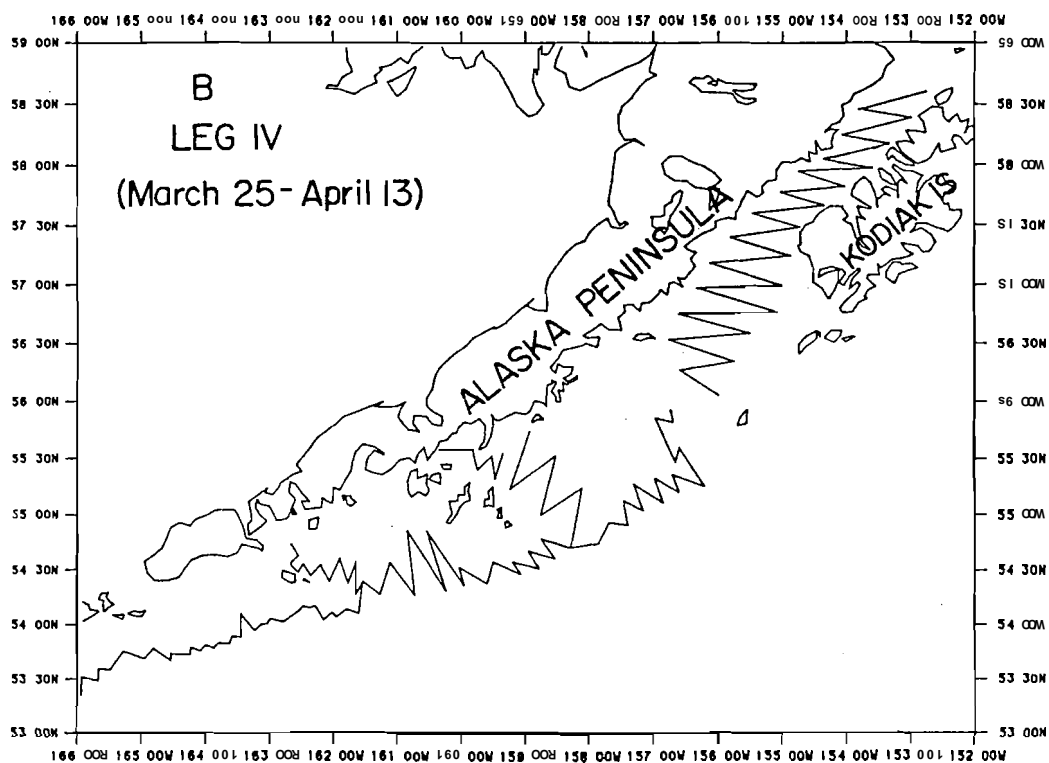
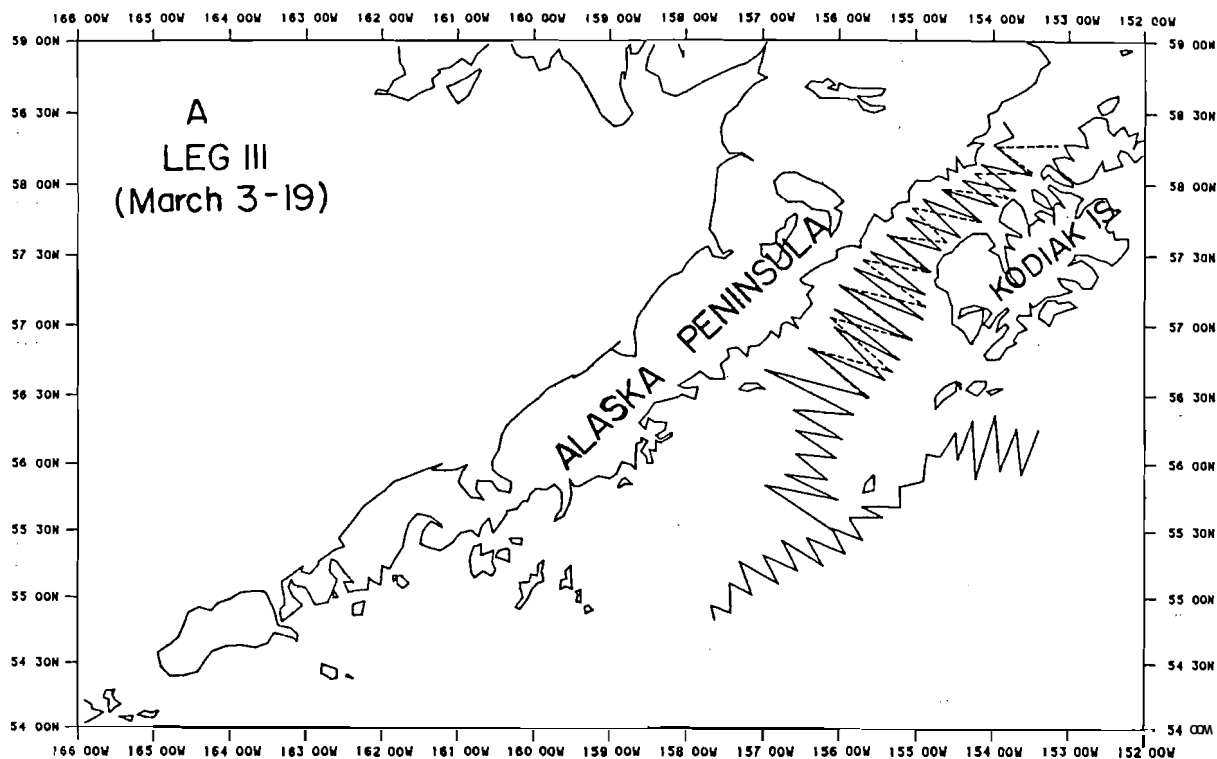


Figure 1. Survey tracklines run by the MILLER FREEMAN during Legs III (A) and IV (B) of Cruise 83-01.

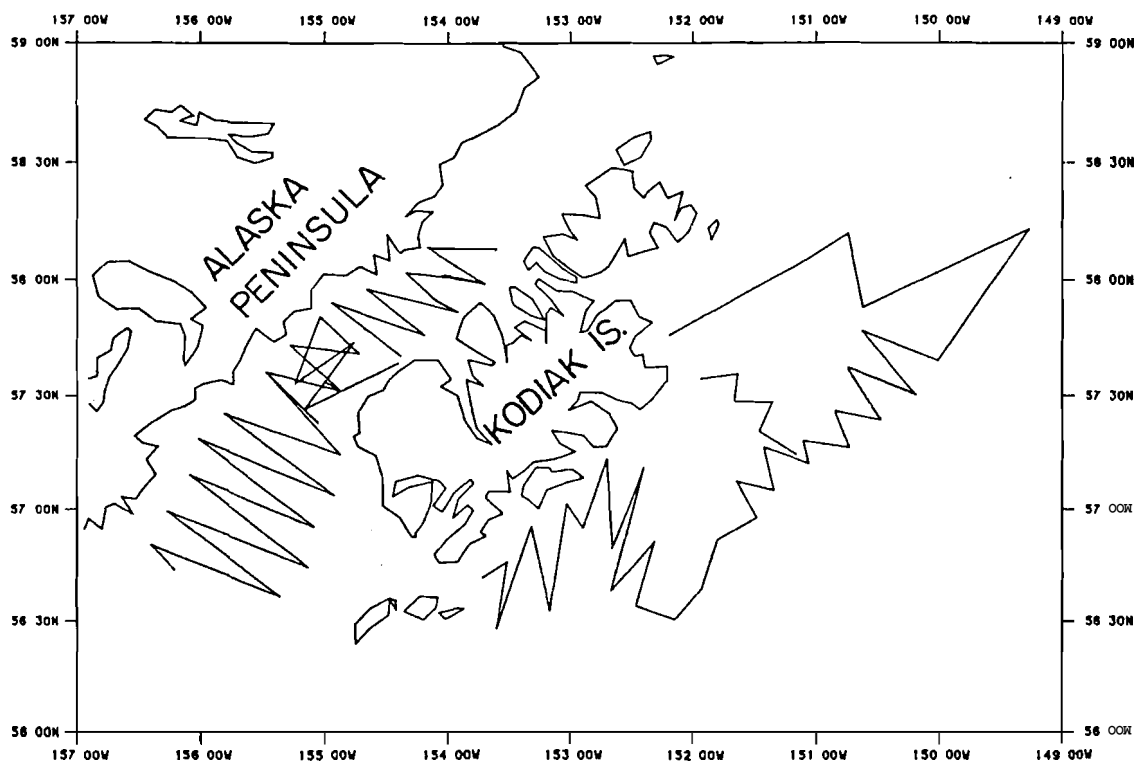


Figure 2. Survey tracklines run by the CHAPMAN during Leg II of Cruise 83-02

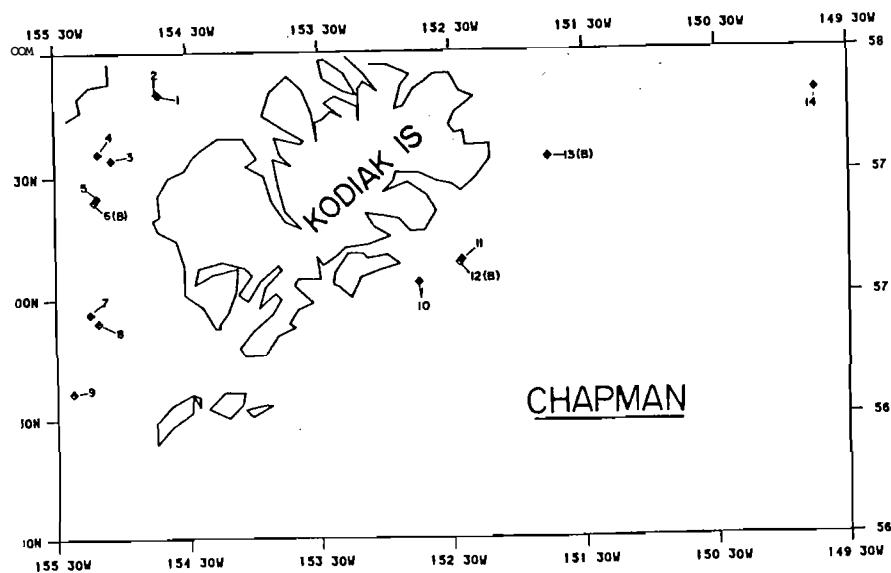
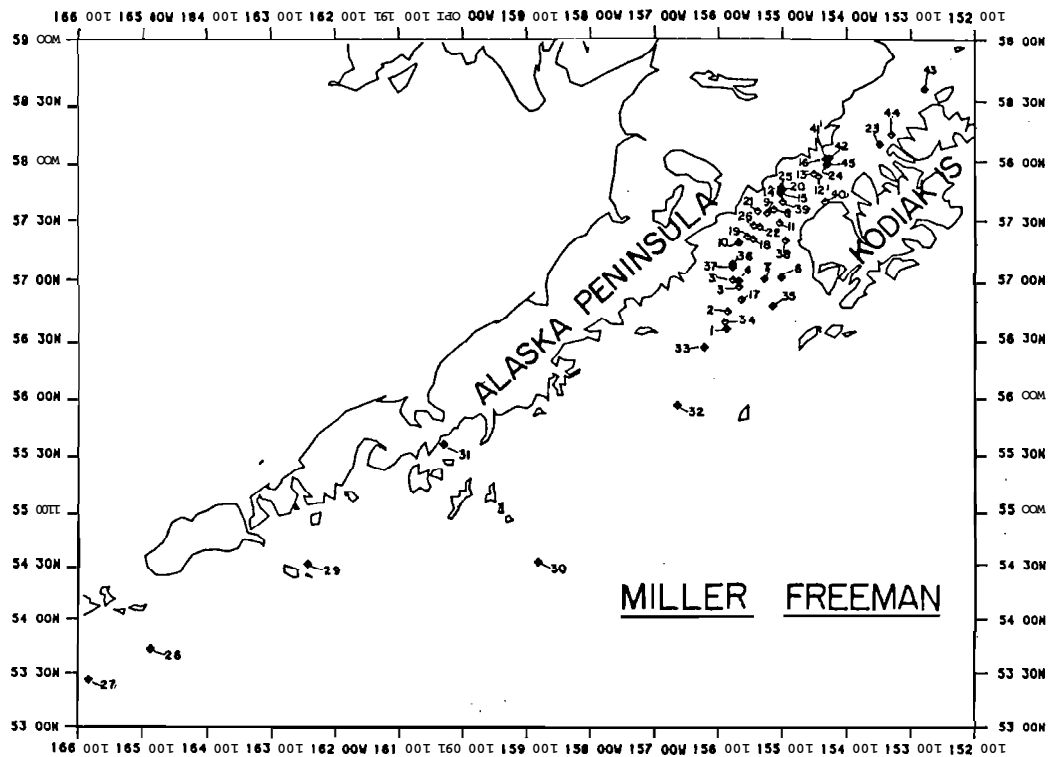


Figure 3. Locations of trawl hauls made by the MILLER FREEMAN during Legs III and IV of Cruise 83-01 (upper) and by the CHAPMAN during Leg II of Cruise 83-02 (lower).

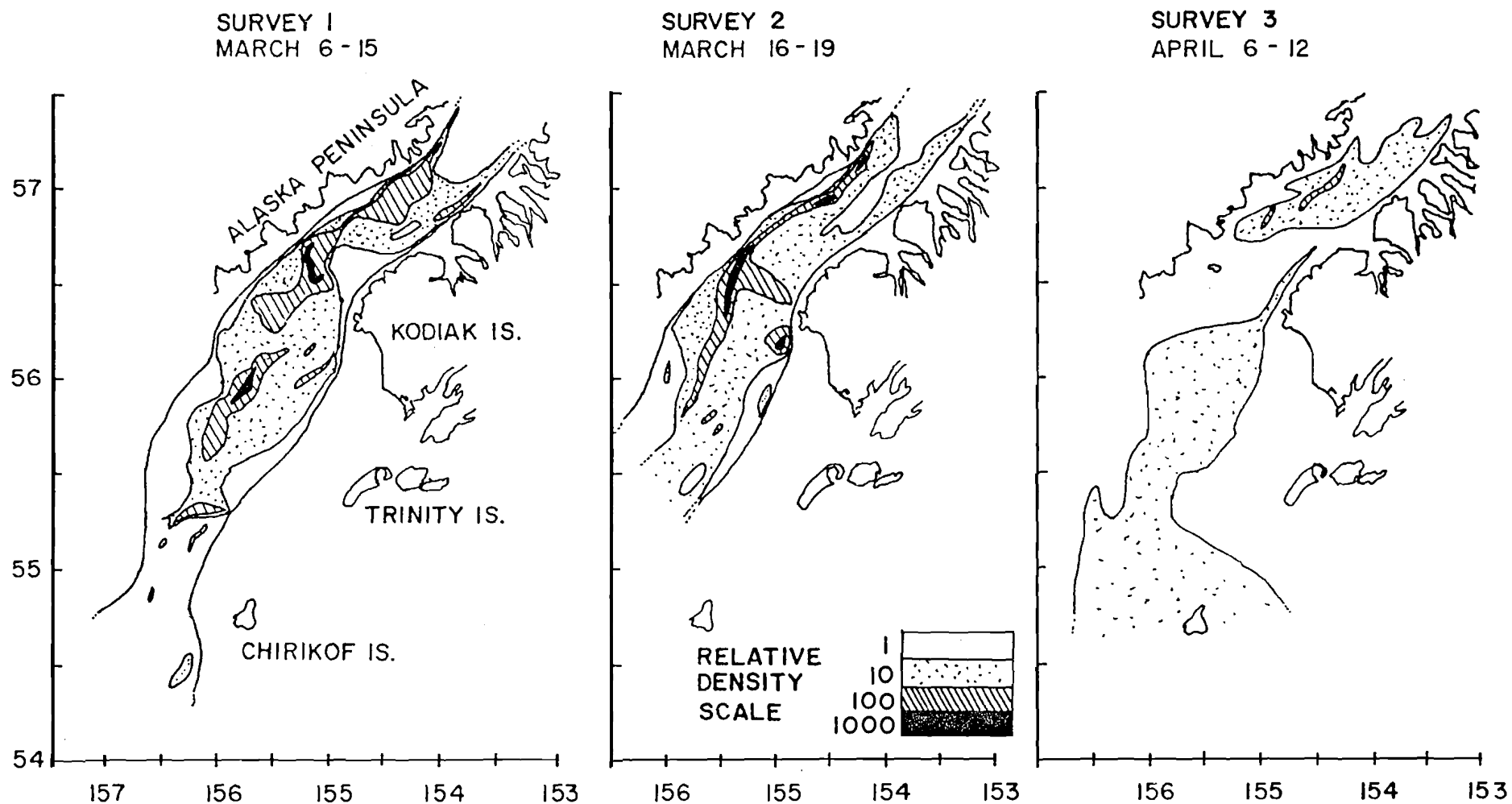


Figure 4. Distribution of relative pollock density in Shelikof Strait during the three surveys conducted by the MILLER FREEMAN; density data from echo integration analysis.